MN2700

MATCHING NETWORK

by DRAKE

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CHAPTER I

INTRODUCTION

1-1. DESCRIPTION.

The typical modern transmitter or high-power amplifier has either a pi-network tank circuit or a broadband transformer output and will work into resistive loads of 50 to 75 ohms with Voltage Standing Wave Ratios (VSWR) of 2:1 or less. This resistive load can only be achieved with a resonant antenna; thus, for multiband operation, multiple antennas are required. Space and cost considerations render this solution impractical for most amateurs. In addition, many single-band antennas will not maintain less than 2:1 VSWR across the entire band. The MN-2700 impedance-matching network can:

1. Measure feedline VSWR, then reduce the VSWR at the transmitter output to 1:1.
2. Monitor transmitter power output in watts directly and continuously.
3. Attenuate 2nd harmonic output from a transmitter by 25 to 35 dB; thus it may eliminate the need for a low-pass TVI filter.
4. Match an antenna to a transmitter having fixed loading.
5. Give optimum match with multiband antennas.
6. Precisely match a transmitter to an antenna across a complete amateur band.
7. Permit off the air transmitter tuning using a dummy load.
8. Eliminate the necessity of retuning the transmitter when switching from "barefoot" to linear amplifier operation since the transmitter always "sees" 50 ohms resistive.
9. Help localize trouble by comparing transmitter output into an antenna and into a dummy load.
10. Allow antenna comparisons with the use of the internal antenna switch.
11. Permit the use of open-wire feedline antenna systems, with the use of an accessory balun.
12. Permit the use of long-wires of various impedances. The accessory balun can be used to match the higher impedance ranges.

1-2. SPECIFICATIONS.

Frequency Coverage:	1.8 to 30 MHz. Band Switch marked for 160, 80, 40, 20, 15, and 10 meter amateur bands; however, frequency coverage between amateur bands is possible by using the nearest band positions with a small reduction in matching capability.
Input Impedance:	50 ohms (resistive).
Load Impedance:	50 ohm coaxial with VSWR of 5:1 or less at any phase angle (3:1 on 10 meters). 75 ohm coaxial at a lower VSWR can be used.
Balanced Feedlines:	With the Drake B-1000 accessory balun, tunes feed point impedances of 40 to 1000 ohms, or 5:1 VSWR referenced to 200 ohms (3:1 on 10 meters).
Long-Wire Antennas:	Feed point impedances up to 5:1 VSWR referenced to 50 ohms. Also, 5:1 referenced to 200 ohms with the Drake B-1000 accessory balun (3:1 on 10 meters).
Power Capability:	1000 watts average continuous duty, 2000 watts PEP
Meter:	Reads VSWR or forward power, 0-200 watts or 0-2000 watts.
Wattmeter Accuracy:	± 5% of reading ± 1% of full scale.
Insertion Loss:	0.5 dB or less on each band after tuning.
Dimensions:	Height: 4-17/32 in. (11.5 cm) Width: 13-3/32 in. (33.26 cm) Depth: 13 in. (33 cm) including connectors.
Weight:	11 lbs. (5 kg)
Front Panel Controls:	Provide for the adjustment of resistive and reactive tuning, antenna switching, band switching, VSWR calibration, and selection of watts or VSWR functions of the meter.
Rear Panel Connectors:	The rear panel has four type SO-239 connectors (one for input and 3 for outputs), three screw terminal connections (for long-wire and open-wire feeder systems), and a ground post.

CHAPTER II

INSTALLATION

2-1. UNPACKING.

Carefully remove the MN-2700 from the shipping carton and examine it for evidence of damage. If any damage is discovered, immediately notify the transportation company that delivered the unit. Be sure to keep the shipping carton and packing material for the transportation company to examine if there is a damage claim. Keeping these items is recommended in any case, since having them available makes shipment of the unit much easier should it ever be necessary to return it to the factory for service.

NOTE

Fill out the enclosed registration card and return it to the factory within 10 days of purchase to insure registration and validation of the warranty.

2-2. LOCATION.

The MN-2700 will work properly in almost any location. Select a location on the operating table that will allow you to reach the control knobs easily. Figure 2-1 illustrates recommended viewing options using the hardware furnished with the unit.

2-3. REQUIREMENTS.

Connect the RF output of your transmitter or amplifier to the XMTR connector of the MN-2700, using 50 ohm coaxial cable such as RG-8/U. Cable length is not critical. In installations using a transceiver or transmitter-receiver combinations, the matching network should be the last item the out-going RF signal passes through before entering the feedline to the antenna. The effects of this on receiver operation will be discussed in Chapter III, Operation, of this manual.

Connect the EXT GND post of the matching network to the station ground with a short piece of heavy braid.

2-4. ANTENNA CONNECTIONS.

Antennas such as beam antennas, single band dipoles, trap dipoles, and verticals fed with coaxial cable should be connected to the rear panel connectors marked ANT 1 or ANT 2.

Connect end-fed long-wire antennas to the rear panel screw terminals labeled LW3 or LW4. A good RF ground should be connected to the EXT GND post. Antennas fed with balanced feedline should be connected as explained in Chapter III, Section 3-3 of this manual.

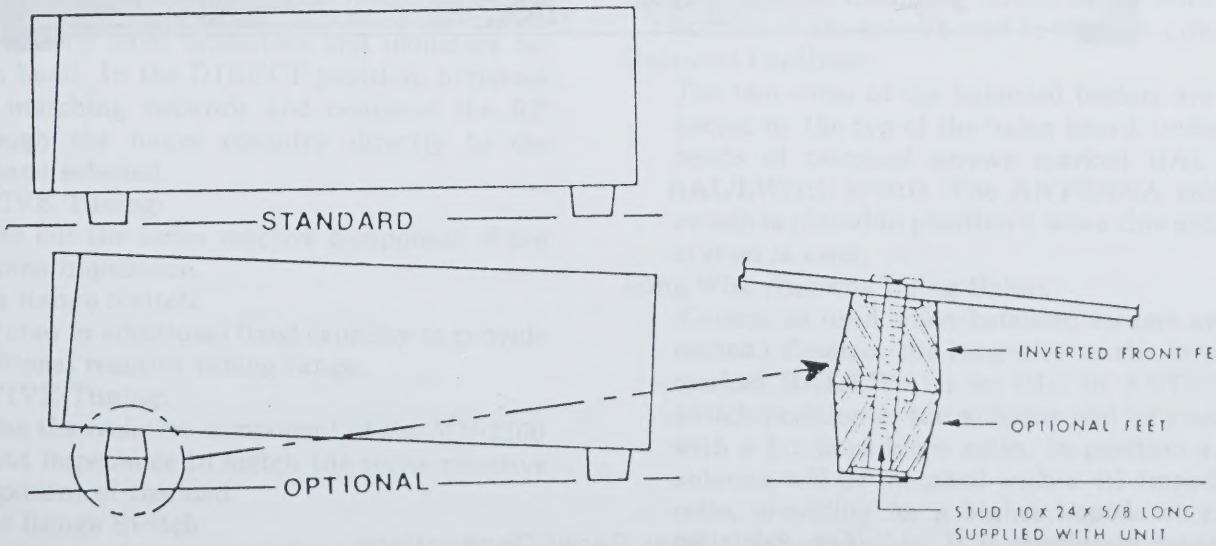

Fig. 2-1 Viewing Angle Options

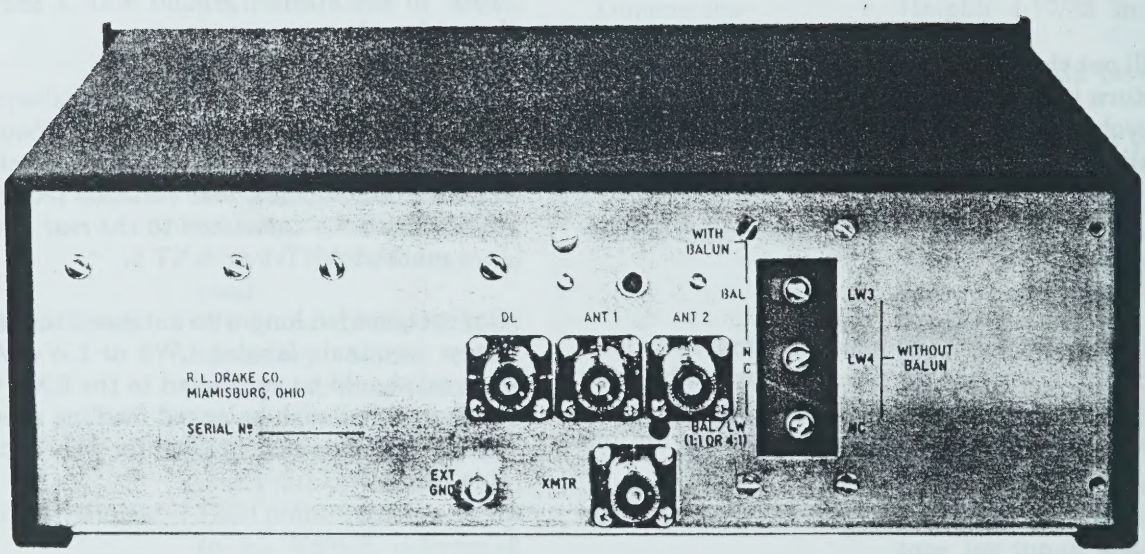

Fig. 3-2 Rear Panel Connections

CHAPTER III

OPERATION

3-1. FRONT PANEL CONTROLS. (Figure 1-1)

VSWR SET Control:
Varies the sensitivity of the VSWR sensing circuitry.

Meter:
Displays either forward power in watts or VSWR as selcted by meter switches.

VSWR SET Switch:
Used to calibrate the meter for VSWR measurements.

VSWR READ Switch:
Causes meter to indicate VSWR.

200 and 2000 Watt Switches:
Causes meter to indicate forward power, either 200 or 2000 watts full scale.

ANTENNA Switch:
Selects the desired antenna and grounds all unused antenna terminals. Positions are provided for Dummy Load (which can also be used for an additional antenna or as a grounding position for antennas 1 through 4), 2 coaxial-fed antennas (1,2) and two long-wire antennas (3,4 without accessory balun). With accessory B-1000 balun, balanced feedline capability or 1:1 and 4:1 match to long-wire antennas are available.

BAND Switch:
Selects the fixed capacitors and inductors for each band. In the DIRECT position, bypasses the matching network and connects the RF through the meter circuitry directly to the antenna selected.

REACTIVE Tuning:
Tunes out the series reactive component of the antenna impedance.

Reactive Range Switch:
Switches in additional fixed capacity to provide additional reactive tuning range.

RESISTIVE Tuning:
Varies the resistive component of the MN-2700 output impedance to match the series resistive component of the load.

Resistive Range Switch:
Switches in additional fixed capacity to provide additional resistive tuning range.

3-2. REAR PANEL CONNECTIONS. (Figure 3-2)

XMTR Jack:
SO-239 socket for input from the transmitter.

DL Jack:
SO-239 socket for the connection of a dummy load (or another coaxial fed antenna).

ANT 1 and ANT 2:
SO-239 sockets for 2 separate coaxial fed antennas.

LW3 and LW4:
Screw terminals for two long-wire antennas, when used without the accessory balun (1:1 impedance ratio to matching range of network). Numbers correspond to ANTENNA selector switch position.

3-3. USE OF THE DRAKE B-1000 ACCESSORY BALUN

Installation:
Remove the three screws at terminals marked LW3, LW4, NC and then re-install these screws through the holes in the balun board to the matching terminals on the MN-2700. Also, install the two mounting screws in the other two corners of the balun board to the MN-2700.

Balanced Feedlines:
The two wires of the balanced feeders are connected on the top of the balun board, under the heads of terminal screws marked BAL and BAL/LW(1:1 or 4:1). The ANTENNA selector switch is placed in position 3 when this antenna system is used.

Long-Wire Antenna Using Balun:
(Cannot be used when balanced feeders are attached.) Connect the long-wire to the terminal marked BAL/LW (1:1 or 4:1). In ANTENNA switch position 3, the antenna will be matched with a 1:1 impedance ratio. In position 4, the antenna will be matched with a 4:1 impedance ratio, providing for a higher impedance range matching capability. It is absolutely necessary to have a good RF ground.

Multiband Antenna:

A doublet antenna 135 feet long, center fed with open-wire feeders 67 feet long, can be matched using the accessory balun on 80 through 10 meters. The feeders make a good 160 meter vertical when connected together and to the BAL/LW (1:1 or 4:1) terminal of the balun.

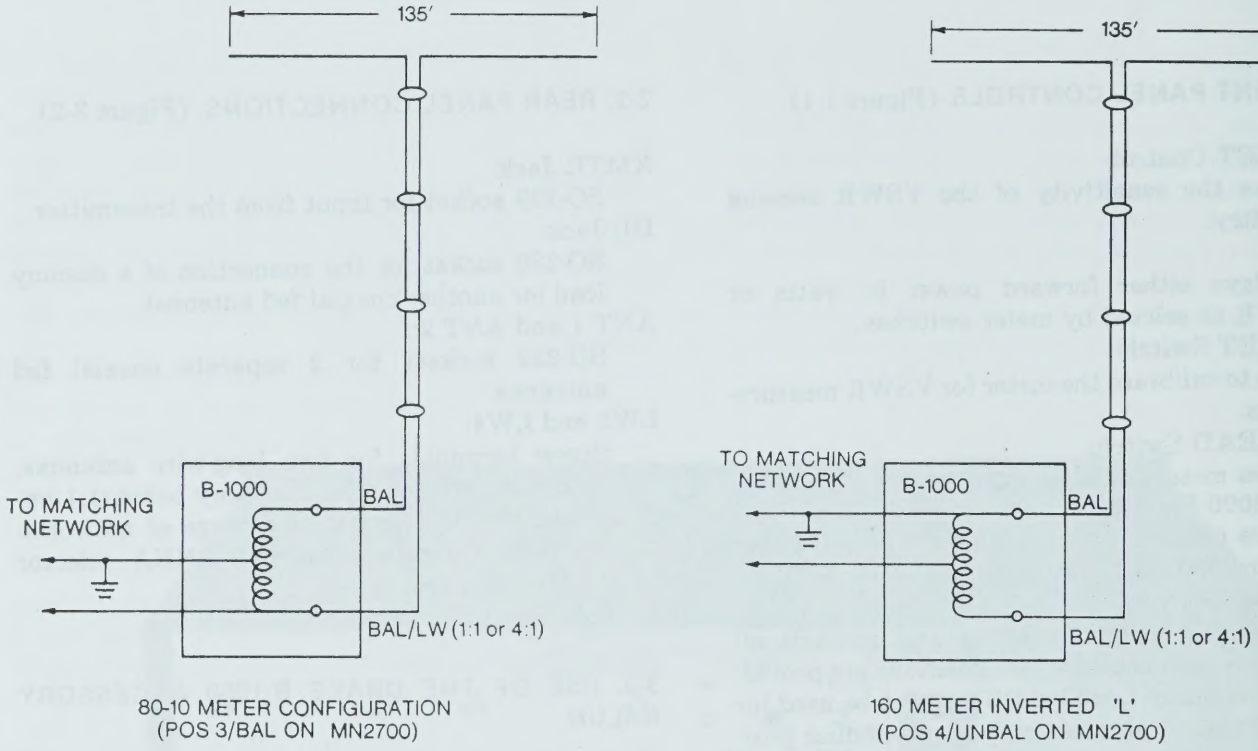

Fig. 3-3 Multiband Antenna

3-4. OPERATING PROCEDURE.

CAUTION

An antenna or a dummy load MUST be connected to the MN-2700 before energizing the transmitter to avoid damage to the matching network and the transmitter. Initial tuning must be done with low transmitter power. Final small adjustments may be made at full power. Do not change any switch positions under high power.

Preset the operating controls as follows:

BAND Switch:	To desired band
Resistive Tuning:	To 5
Reactive Tuning:	To 5
Resistive Range:	To 0 - 10
Reactive Range:	To 0 - 10
VSWR Set Control:	Fully Counterclockwise
Meter Switches:	To VSWR READ

Energize the transmitter, apply low power to the matching network, adjust the transmitter plate tuning to resonance, and adjust loading to minimum (max. capacity). The VSWR meter should read upscale. Vary the RESISTIVE tuning until the VSWR dips. If there is not enough tuning range to dip the VSWR, switch in or out the resistive range capacitor as needed to dip the VSWR. Then turn the

REACTIVE tuning control clockwise. Readjust the RESISTIVE tuning for a dip. If this dip is downscale from the first dip, you are tuning in the right direction, and should continue to alternately move the REACTIVE tuning control clockwise and tune the RESISTIVE tuning for a dip, until a minimum VSWR indication is obtained. If the second dip found reads higher on the meter than the first dip, the REACTIVE tuning control must be turned counterclockwise a short distance, and the RESISTIVE tuning adjusted for a dip. Continue alternating these actions until a minimum VSWR reading is reached. Again, if additional tuning range is needed, switch in or out the range capacitors to obtain minimum VSWR reading.

If the dips found during the tuning procedure are so far downscale that it becomes difficult to tell whether a particular dip is lower or higher than the preceding one, you can increase the meter sensitivity and get readings that are farther upscale by turning the VSWR SET knob clockwise. With this added sensitivity it may not be possible to dip to the meter zero, but any residual reading will represent a very small power level, probably less than 0.1 watt.

When the matching network has been adjusted to the lowest possible dip, it is properly tuned to present a 50 ohm resistive load to the transmitter. Adjust the transmitter plate tuning and loading controls as directed by the transmitter instruction manual.

Make a note of the settings of the RESISTIVE and REACTIVE tuning and range controls, and the BAND switch. The next time you operate on this band, you can tune up quickly by returning the MN-2700 controls to the same settings.

With the range switch in 0-10 position, the tuning control would be recorded as the number on the knob dial between 0 and 10. With the range switch in the 10-20 position, 10 should be added to the number on the dial - record a number between 10 and 20. In the 20-30 switch position, add 20 and record a number between 20 and 30.

Push the VSWR SET button and rotate the VSWR SET knob clockwise until the meter needle lines up with the SET mark (full-scale) on the meter face. Push the VSWR READ button. The meter will now indicate VSWR.

3-5. OFF-THE-AIR TUNING.

If a 50 ohm dummy load that is capable of handling full transmitter power output is available, it and the MN-2700 can be used to tune up with minimum interference. Connect the 50 ohm dummy load to DL connector on the MN-2700, switch the ANTENNA switch to GND/DL, switch the BAND switch to DIRECT, and turn on the transmitter. The transmitter (and high-power amplifier, if used) can now be tuned to match the 50 ohm dummy load. Then turn off the amplifier and reduce the transmitter power output, without changing the transmitter tuning. As little as 10 watts input to the MN-2700 is enough. Set the BAND switch to the desired band, the ANTENNA switch to the desired antenna, tune the matching network for minimum VSWR, and then increase the transmitter power to normal operating level.

3-6. REFLECTED POWER.

It is possible to read reflected power with the MN-2700, although the instrument was not primarily designed to do this. To read reflected power, first rotate the VSWR SET knob fully counterclockwise, and press either the 200 WATTS or 2000 WATTS meter switch. Increase transmitter power to the desired level (do not exceed full scale on the meter), then press the VSWR SET button. Rotate the VSWR SET knob clockwise until the meter indicates the same forward power. Press the VSWR READ button. The meter now indicates reflected power.

3-7. USE WITH TRANSCEIVERS OR T/R COMBINATIONS.

Adjustment of the MN-2700 with a transceiver is done exactly as described in Sections **3-4** and **3-5** Since the received signal will be passed through the matching network, it is necessary to change the BAND switch to either DIRECT, or to the band the receiver is tuned to. If this is not done, the received signal will be attenuated by the matching network whenever the BAND switch setting is not the same as the band being tuned.

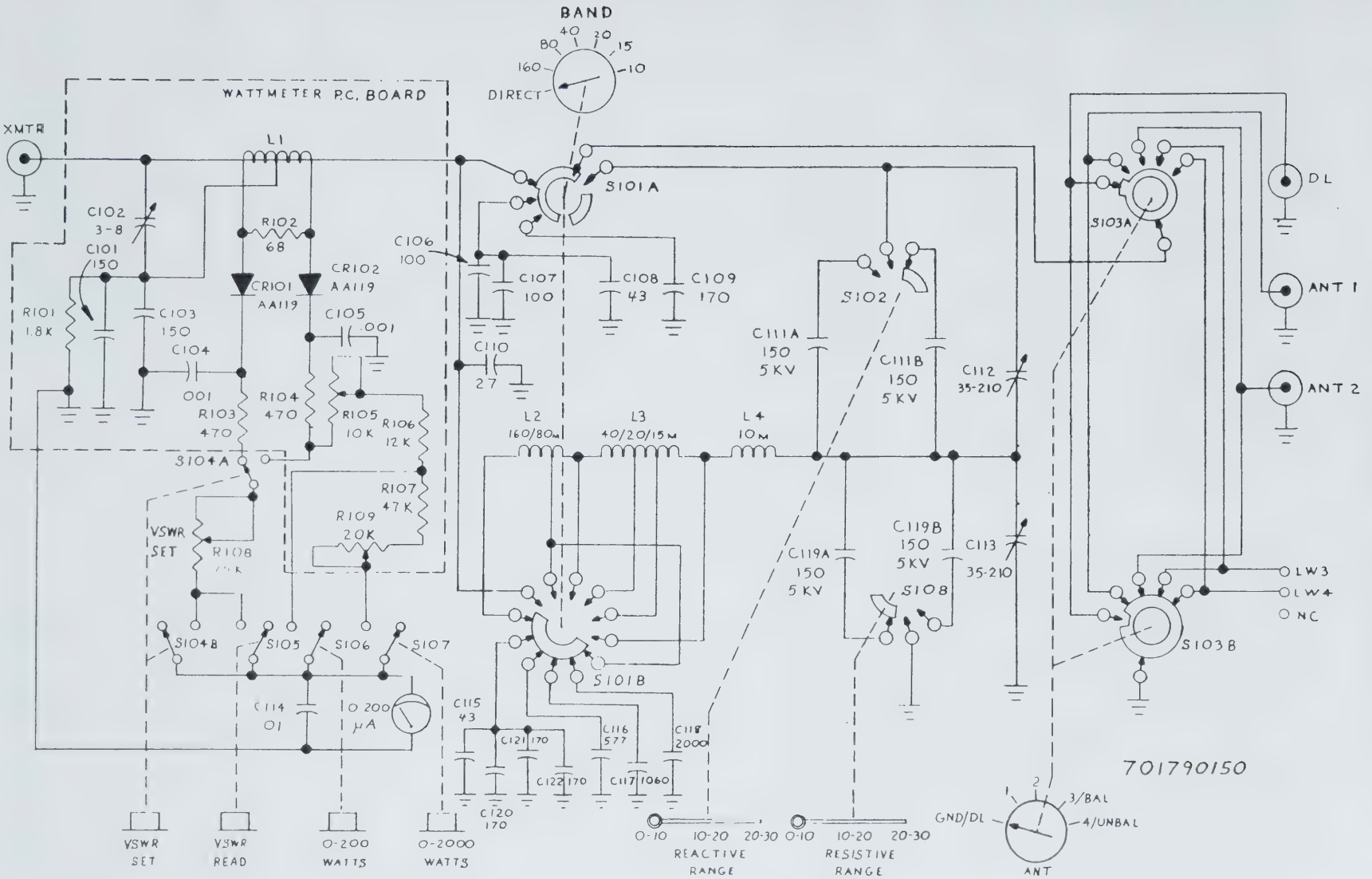

Fig. 4-1 MN2700 Schematic Diagram

160 METER ANTENNA

The Drake MN-2700 and MN-7 Matching Networks are instruments with a truly unique antenna feed switching design. They will completely change the mode of a balanced-line fed 135 foot doublet to a special configuration that provides very effective 160 meter performance. And best of all, it's done with the simple flip of a switch on the front panel.

Consider a typical all-band antenna set-up — a 135 foot doublet, center-fed with 60 to 70 feet of balanced line at a height of 45 to 60 feet. The Drake MN-2700/B-1000 or MN-7/B-1000 will match this as a true balanced system on 80 thru 10 meters. (Fig. 1)

But what about 160 meters? Many amateurs recommend tying the feeders together and using the antenna as a vertical with a "top-hat". In fact, we suggest this ourselves in our manual. However, the use of this, or any vertical, assumes you have a good ground or radial system for efficient operation. If you do not have enough room or do not wish to install such a radial system, performance may suffer. And if you do have radials, you still have to change the feeder connections each time you operate 160 meters.

On the other hand, when you use the MN-2700/B1000 or MN-7/B-1000 simply leave the feeders in the balanced connection as you would for 80 thru 10, and move the special antenna selector switch to Position No. 4. This automatically converts half of the antenna and feedline to an inverted "L", fed through a 4:1 impedance transformer, with the other half operating as a counterpoise. (Fig. 2)

This system offers the convenience of "stay in your chair" operation, while providing an effective means of operating 160 meters with a relatively small antenna.

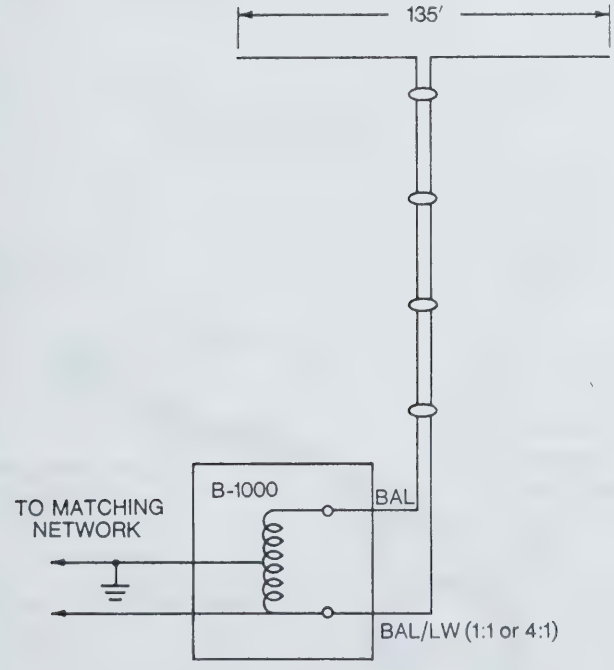

FIG. 1 80-10 METER CONFIGURATION
(POS 3/BAL ON MN7 & MN2700)

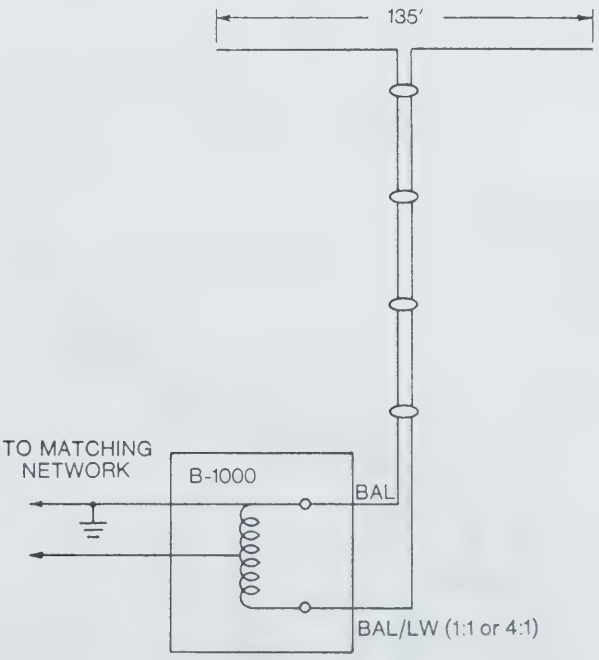

FIG. 2 160 METER INVERTED 'L'
(POS 4/UNBAL ON MN7 & MN2700)

DRAKE B-1000 BALUN

Instruction Sheet

General Description:

The B-1000 Balun is a precision engineered, bifilar wound, toriod, matching transformer designed primarily for use with Drake antenna matching networks. A 4:1 impedance ratio between antenna and matching network is provided by the B-1000, extending the effective tuning range of most matching networks. The B-1000 can be operated at continuous power levels up to 1000 watts, insuring maximum transfer of power and minimum reflection under most conditions. The B-1000 is intended for use in indoor installations.

Installation:

Drake antenna matching networks of recent design have provisions on the rear panel for mounting the B-1000 Balun to the unit. Installation details for these units can be found in Chapter III of the instruction manual in the paragraph entitled "Use of the Drake B-1000 Accessory Balun".

Drake antenna matching networks of traditional design, such as the Drake MN-4 or MN-2000, will accept the B-1000 as an outboard accessory. By following the appropriate installation diagram (shown below) it is possible to install the B-1000 Balun into either open wire feeder systems or systems utilizing long wire antennas.